CASE REPORT

Ciliochoroidal detachment following pure sulfur hexafluoride injection in Descemet stripping automated endothelial keratoplasty

Descemet stripping automated endothelial keratoplasty (DSAEK) is an effective and safe treatment for Fuchs dystrophy and pseudophakic corneal edema, among other ocular conditions.[1–3] The most common complication of this surgical procedure is graft detachment, which may be effectively resolved in most cases by rebubbling with air or gas (or both) to reposition the graft.[1–3]

After endothelial transplantation, the injection of air or sulfur hexofluoride (SF_6) in the anterior chamber has proven to be effective in fixing the graft to the host posterior cornea.[4] Although the use of air compared with SF_6 has been linked to a slightly higher rate of graft displacement on postoperative day 1, both methods are safe and usually free of complications.[3,4]

A 64-year-old woman with a history of Fuchs endothelial dystrophy, corneal decompensation, and cataract (Fig. 1A) underwent a triple procedure: phacoemulsification, posterior chamber intraocular lens placement, and DSAEK in the right eye. Axial length was 24.6 mm, and anterior chamber depth was 3.34 mm. An Nd:YAG laser iridotomy was performed before the surgery.

The surgical procedure was successful and without complications. The method used to fix the donor graft disc at the end of the surgery was an injection of 0.3 mL of SF_6. Our standard technique is to carefully mix 20% in a large syringe and then inject the solution into the anterior chamber to support the graft.

On the first postoperative day, an intraocular pressure (IOP) peak of 41 mm Hg was normalized in 24 hours with oral acetazolamide and topical beta-blockers. The anterior chamber was very deep and fully occupied by the SF_6 gas (Fig. 1B). However, on the fourth postoperative day, IOP had fallen to 0 mm Hg. The incisions had been correctly sealed, and the Seidel test was negative. The lamellar graft was transparent, showing many endothelial folds, and yet was properly adhered to the corneal stroma. Ultrasound-B did not reveal choroidal detachments. At this point, we checked the operating room record for the patient, and we noticed that because of a human error, the concentration of the SF_6 gas injected was pure, or 100%, because the supposed standard mixed concentration to obtain a 20% concentration had not been performed.

Despite treatment with topical and oral corticosteroids, atropine, rest, and positioning, the patient's IOP did not return to normal, and after the first postoperative week, the graft began to detach (Fig. 2A) creating a false anterior chamber. Anterior-segment optical coherence tomography

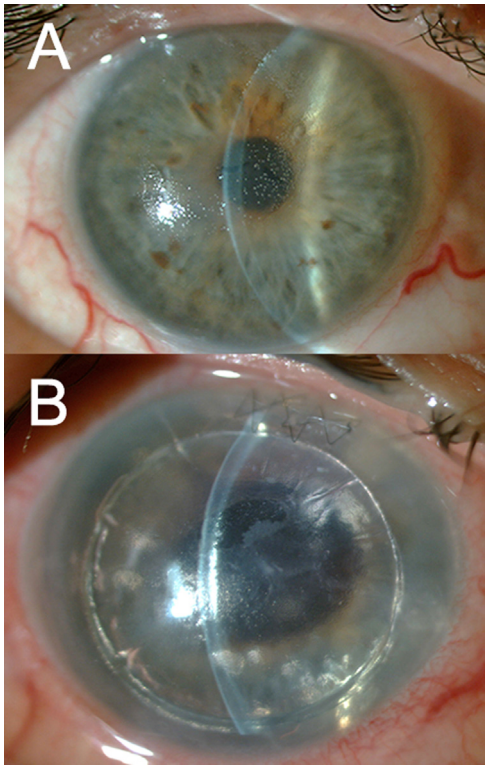

Fig. 1—A, Fuchs dystrophy: preoperative slit lamp picture of the right eye. B, Appearance 24 hours after surgery. The graft is correctly attached to the stroma and well centred, showing several folds; the anterior chamber is fully occupied by gas. Note deepening of the anterior chamber.

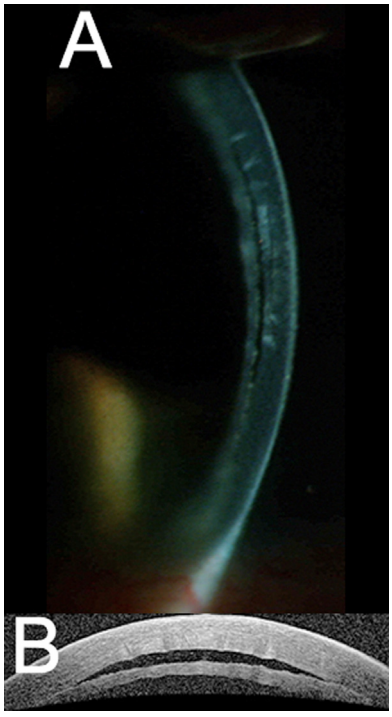

Fig. 2—A, Initial detachment of the graft from the stroma at the end of the first postoperative week. B, Anterior segment optical coherence tomography showing the detached graft creating a false anterior chamber.

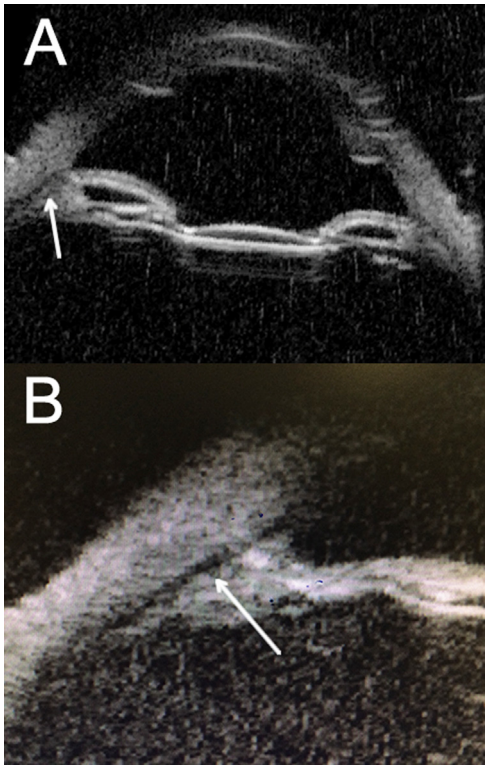

Fig. 3—A, Ultrasound biomicroscopy of the anterior segment of the eye. This image shows ciliochoroidal detachment from the scleral spur and a large space between the endothelial graft and intraocular lens as a result of a deep anterior chamber distended by the SF_6 gas. B, The ciliochoroidal detachment causing hypotony shown in more detail by ultrasound biomicroscopy.

(AS-OCT) showed complete detachment of the graft in its central area (Fig. 2B); ultrasound biomicrosopy (UBM) revealed detachment of the ciliary body from the scleral spur, mainly in the lower half of the angular circumference (Figs. 3A and 3B).

After graft repositioning by rebubbling with air, the hypotony resolved over the next 4 weeks. At this stage, the cornea was transparent, the graft was well adhered to the stroma without folds (Fig. 4A), the anterior chamber had recovered its normal depth, the pupil remained centred and round, the intraocular lens was in the capsular bag, and the iris had acquired a peripherally radiating atrophied appearance showing severe transillumination (Fig. 4B). The OCT showed the graft reattachment (Fig. 4C), and a final UBM confirmed reattachment of the ciliary body to the sclera (Fig. 4D).

In this report, we presented an uncommon complication of successful DSAEK surgery. The use of SF_6 as a tamponade agent in DSAEK surgery to help adhere the donor graft has been reported as a safe technique, comparable with the use of air.[3,4] As far as we know, this is the first reported case of ciliary body detachment after SF_6 pure gas injection into the anterior chamber during DSAEK. We believe that the mechanism of ciliary body detachment in our patient could have been the high pressure produced by the 100% SF_6 occupying the whole anterior chamber. It is known that the maximal expansion of this gas is produced after 24 to 48 hours, its expansivity being 2 if the gas is pure.[5] However, the safety of 0.25 mL of SF_6 even at 100% concentration has been described in one case.[6] The anterior chamber was not shallow in our patient, so we think that the volume of 0.3 mL was adequate.

The initial IOP peak observed was likely attributable to acute glaucoma provoked by anterior pupillary and iridotomy block. This was followed by ciliochoroidal detachment, probably caused by the high pressure

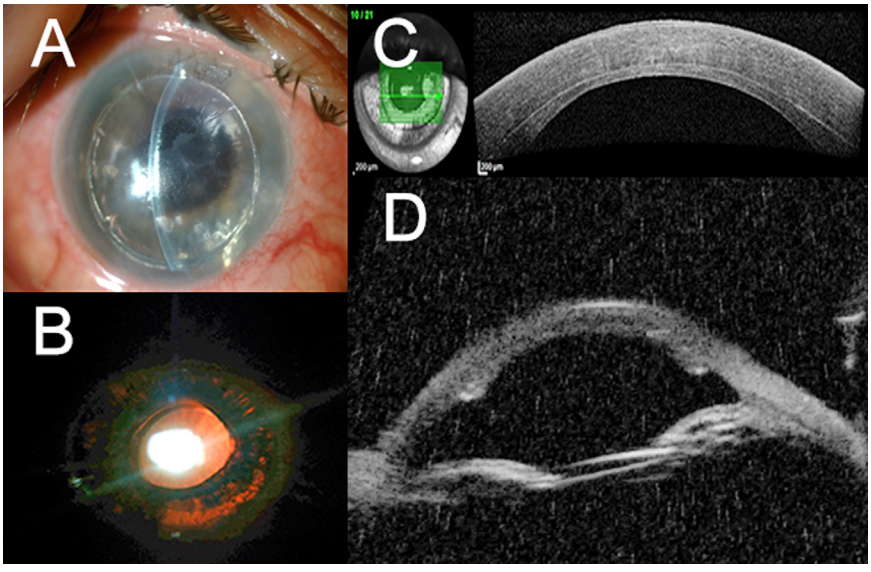

Fig. 4—A, Reattachment of the endothelial graft to the stroma by an air bubble. B, One month after surgery, the graft appears to be well attached as shown by optical coherence tomography. C, Slit-lamp transillumination of iris atrophy after pigment dispersion syndrome caused by compression by the large gas bubble. D, Reattachment of the ciliary body was confirmed by ultrasound biomicroscopy.

produced by the gas being the zone of least resistance, so the angle became separated from the scleral spur. Thus, severe hypotony would be the outcome of increased outflow of aqueous humor through the uveoscleral route. This hypotony would have consequently provoked graft dislocation. Other authors have related hypotony after DSAEK to previous glaucoma surgery, and hypotony itself has been linked to a significantly increased rate of graft dislocation.[7,8] It is important to note than in the study by Goshe et al., no instances of postoperative hypotony were identified in control eyes (patients without previous glaucoma surgery).[8]

Another possible explanation, but certainly uncommon, could be the acetazolamide used to treat the IOP peak, given a report of profound hypotony and choroidal detachment related to this medication.[9] Another less likely cause of ciliochoroidal detachment could be transient blockage of aqueous humor production secondary to ischemia of the ciliary body caused by acute IOP elevation. However, ciliary body detachment was confirmed by UBM as the primary cause of the hypotony. In addition, pigment dispersion syndrome was observed, and this confirmed the high pressure in the anterior chamber induced by the SF_6 gas causing mechanical trauma through the iris.

The main causes of ciliochoroidal detachment are usually trauma or surgery,[7,8] mainly glaucoma surgery, but detachment also has been described after hyperopic phakic IOL implantation and prophylactic surgical iridectomy.[10] Although diagnosis used to be based on gonioscopy, an imaging technique, such as UBM, may be needed.

This unusual complication of graft fixation by SF_6 in a DSAEK procedure highlights the importance of properly managing the gas concentration in intraocular surgical procedures.

Disclosure The authors have no proprietary or commercial interest in any materials discussed in this article.

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References

1. Suh LH, Yoo SH, Deobhakta A, et al. Complications of Descemet's stripping with automated endothelial keratoplasty: survey of 118 eyes at One Institute. *Ophthalmology*. 2008;115:1517-24.
2. Price MO, Gorovoy M, Benetz BA, et al. Descemet's stripping automated endothelial keratoplasty outcomes compared with penetrating keratoplasty from the Cornea Donor Study. *Ophthalmology*. 2010;117:438-44.
3. Terry MA, Shamie N, Chen ES, et al. Endothelial keratoplasty for Fuchs' dystrophy with cataract: complications and clinical results with the new triple procedure. *Ophthalmology*. 2009;116:631-9.
4. Acar BT, Muftuoglu O, Acar S. Comparison of sulfur hexafluoride and air for donor attachment in Descemet stripping endothelial keratoplasty in patients with pseudophakic bullous keratopathy. *Cornea*. 2014;33:219-22.
5. Kontos A, Tee J, Stuart A, Shalchi Z, Williamson TH. Duration of intraocular gases following vitreoretinal surgery. *Graefes Arch Clin Exp Ophthalmol*. 2016;255:231-6.
6. Ellis DR, Cohen KL. Sulfur hexafluoride gas in the repair of Descemet's membrane detachment. *Cornea*. 1995;14:436-7.
7. Vela MA, Campbell DG. Hypotony and ciliochoroidal detachment following pharmacologic aqueous suppressant therapy in previously filtered patients. *Ophthalmology*. 1985;92:50-7.
8. Goshe JM, Terry MA, Li JY, Straiko MD, Davis-Boozer D. Graft dislocation and hypotony after Descemet's stripping automated endothelial keratoplasty in patients with previous glaucoma surgery. *Ophthalmology*. 2012;119:1130-3.
9. Macken P, Barton K, Lonides A, Hitchlings RA. Ciliochoroidal detachment after aqueous suppressant therapy. *J Glaucoma*. 1995;4:344-5.
10. Arnalich-Montiel F, Ruiz-Casas D, Muñoz-Negrete F, Rebolleda G. Inadvertent cyclodialysis cleft and annular ciliochoroidal detachment after hyperopic phakic intraocular lens implantation and prophylactic surgical iridectomy. *J Cataract Refract Surg*. 2015;41:2319-22.

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